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Original Research Article

Eye donation at a newly established eye bank of a government medical college of eastern India: a three-year retrospective analysis of sources, retrieval logistics and tissue utilisation

Saubhik Chattopadhyay[1], Anil Kumar Ghanta[2], Ophelia Mukherjee[3]*

[1]Susrut Eye Foundation and Research Centre, Berhampore, West Bengal, India
[2]Department of Ophthalmology, Mandakini Medical College and Hospital, Ranaghat, West Bengal, India
[3]Department of Community Medicine, Rampurhat Government Medical College and Hospital, Rampurhat, West Bengal, India

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***Correspondence:**
Dr. Ophelia Mukherjee,
E-mail: dr.ophelia.mukherjee@gmail.com

ABSTRACT

Background: Corneal blindness is a priority avoidable condition whose treatment depends entirely on donated tissue. We reported three years of donor tissue procurement at a newly established peripheral government eye bank in a densely populated, district of eastern India, examining the sources, geography and logistics of retrieval.
Methods: We retrospectively analysed all 320 eye donations received from the eye bank's inception (8 April 2022) to 31 March 2025. Donations were classified by procurement source- external non-governmental organisation (NGO) eye retrieval centre (ERC), local NGO ERC or own hospital cornea retrieval programme (HCRP)- and by district of origin. Retrieval intervals were compared across sources by Kruskal-Wallis and Mann-Whitney tests, and utilisation derived by linking donors to keratoplasties performed.
Results: The 320 donors yielded 638 corneas. Despite continuous information-education-communication activity, local procurement remained minimal: only 74 donors (23.1%) came from the host district and 7 (2.2%) through the hospital's own HCRP, while 245 (76.6%) were retrieved by a single external NGO ERC in a neighbouring district. Consequently 318 donors (99.4%) were Hindu, although the host district was Muslim-majority. Donors were elderly (mean 72.3±12.2 years; 87.2% aged ≥60 years). Mean death-to-enucleation was 3.71±1.56 hours, but transport differed markedly by source (4.31 versus 1.67 versus 0.90 hours; $p<0.001$), reaching 16 hours. Only 309 corneas (48.4%) were used for keratoplasty.
Conclusions: Local eye donation remained persistently low despite sustained awareness activity, obliging near-total dependence on an external retrieval centre in a neighbouring district. The resulting long transport times, with advanced donor age, define twin priorities of community-specific engagement and logistic strengthening.

Keywords: Corneal blindness, Eye banking, Eye donation, Health services accessibility, Hospital cornea retrieval programme, Tissue donors

INTRODUCTION

Diseases of the cornea are a major cause of blindness worldwide, second only to cataract in overall importance, and most of the resulting visual loss is avoidable.[1] Corneal transplantation is the definitive treatment and is the most frequently performed transplantation procedure in the world, yet its reach is limited everywhere by the supply of donor tissue. A survey of 148 countries identified 184,576 corneal transplants performed in 2012 from 283,530 procured corneas, quantified the shortage as only one cornea available for every 70 needed, and found that about 53% of the world's population had no access to corneal transplantation at all.[2] The deficit is greatest in

the low- and middle-income regions that carry the heaviest disease burden and where the causes of corneal blindness are largely preventable.[3]

India carries a substantial share of this burden. A recent national survey using rapid assessment of avoidable blindness methodology in 31 districts estimated the prevalence of avoidable blindness due to corneal opacities at 17.1 per 10,000 (95% confidence interval 13.4-21.9) in the population aged 50 years and above, with higher prevalence at older ages and lower educational status.[4] Corneal blindness is accordingly a priority condition under the National Programme for Control of Blindness and Visual Impairment (NPCBVI), which supports eye banks through recurring and non-recurring grants and sets targets for eye banks and eye donation centres linked to the Vision 2020 framework.[5] India has built one of the largest eye-banking networks in the world, with around 740 members registered under the Eye Bank Association of India and a highest-ever annual collection of 71,700 donor eyes in 2017-18, but its output is uneven and chronically short of need.[6] Two procurement models dominate. The hospital cornea retrieval programme (HCRP) seeks consent from families of patients who die within the hospital and consistently achieves the highest tissue-utilisation rates, of the order of 50%, whereas voluntary and community donation, though vital for volume, yields utilisation of only about 22-28%.[6,7] Non-governmental organisation (NGO) eye retrieval centres (ERCs) extend this reach into the community and, where they are energetic, can become the mainstay of a region's supply.[8] Throughout, the willingness of the next of kin to consent remains the rate-limiting step, and awareness, cultural attitudes, religious belief and the quality of grief counselling are its principal determinants.

These determinants are not evenly distributed, and Indian community-based evidence consistently shows a wide gap between awareness and willingness that is socially patterned. In the population-based Tripura Eye Survey, 61.4% of 2,440 participants aged 40 years and above had heard of eye donation but only 3.8% were willing to pledge their eyes, with fear of disfigurement (76.9%) and religious reasons (14.8%) the leading stated barriers.[9] A community survey of 2,004 adults in 20 urban slum clusters of Delhi found awareness and willingness to pledge both significantly higher among Hindu respondents and among those of higher caste ($p<0.001$).[10] Among stakeholders in Srikakulam district, 93% were aware and 82% willing, whereas in Perambalur 83.6% supported organ donation but only 16.8% had pledged and 5% had registered, with misconceptions, cultural beliefs and religious concerns identified as key barriers.[11,12] Together these findings indicate that procurement is shaped less by the presence of an eye bank than by the social composition and beliefs of the community around it. Almost all published Indian eye-banking data, however, come from high-volume institutional eye banks in the south and north of the country. We did not find any published research describing the procurement geography of a newly established peripheral government eye bank situated in a district whose majority community donates rarely, nor any that quantifies the logistic penalty of depending on retrieval partners located in another district.

In this context, we conducted the present study to describe the sources and geography of the donor corneal tissue procured by a peripheral government eye bank during its first three years; to characterise donor demographics, the pattern of consent and the certified cause of death; to quantify retrieval logistics, in particular the death-to-enucleation and transport intervals and their variation by procurement source; and to relate donor age and these intervals to the proportion of retrieved tissue ultimately used for keratoplasty.

METHODS

Study design, setting and duration

This was a retrospective, record-based observational analysis of a consecutive donation cohort at the eye bank of Murshidabad Medical College and Hospital, a government tertiary teaching institution in Berhampore, West Bengal. The eye bank was established on 8 April 2022 and the study window ran from inception to 31 March 2025, a period of 36 months. Murshidabad is a populous, predominantly rural district of approximately 7.1 million people, about two-thirds of whom are Muslim.[13] The eye bank operates through its own HCRP and through partnership with non-governmental ERCs. Reporting follows the strengthening the reporting of observational studies in epidemiology (STROBE) statement for cross-sectional and cohort studies.

Study population and sampling

All eye donations recorded in the eye bank donor register during the study window were eligible for inclusion. Donations whose date of death fell after 31 March 2025 were excluded. No sampling was applied and no sample-size calculation was therefore required: the study was a complete enumeration of the programmatic donor cohort, and all 320 eligible donors were analysed.

Procurement source classification and definitions

Each donation was assigned to one of three procurement sources on the basis of the recorded retrieving agency and place of death. An external NGO ERC denoted a charitable retrieval centre based in Santipur, in the neighbouring district of Nadia, which accounted for the great majority of retrievals; a local NGO ERC denoted a retrieval centre operating within the host town of Berhampore; and own HCRP denoted retrieval by hospital staff following an in-hospital death. Donations were additionally classified by district of origin as Nadia, Murshidabad or other. The death-to-enucleation interval was defined as the time from certified death to

completion of enucleation, and the retrieval-to-eye-bank (transport) interval as the time from enucleation to receipt of the tissue at the eye bank; both were expressed in hours.

Data sources and variables

Data were abstracted from the eye bank donor register by a single investigator using a pre-designed proforma. Collected variables comprised donor age, sex and religion; the relationship of the consenting next of kin; the place and certified cause of death; the retrieving agency; the number of corneas received; and the timestamps of death, enucleation and receipt of tissue at the eye bank. The register's religion and sex fields, which were transposed in a minority of entries, were corrected using the deterministic rule that 'H' denotes religion (Hindu) and 'F' denotes sex (female); ambiguous single-letter entries were resolved conservatively. No value was imputed; time analyses used complete cases and the number of records contributing to each interval is reported.

Data management and analysis

Analyses were performed in SPSS version 27. Continuous variables are summarised as mean±standard deviation, with the median reported additionally where the distribution was skewed; categorical variables are summarised as frequency and percentage to one decimal place. Because retrieval intervals were right-skewed, they were compared across the three procurement sources by the Kruskal-Wallis test and, for the external versus local ERC contrast, by the Mann-Whitney U test. Monthly donation volume was modelled against calendar-month index by ordinary least-squares linear regression. Tissue utilisation was derived by linking the donor cohort to the keratoplasties performed over the same period. A two-sided p value below 0.05 was considered statistically significant.

Ethical considerations

The study adhered to the Declaration of Helsinki and was approved by the institutional ethics committee of Murshidabad Medical College and Hospital (MSD/MCH/PR/1851/B/2025 dated 02/06/2025). Anonymised programmatic records were analysed retrospectively and the requirement for individual informed consent was waived by the committee. Donor and family identifiers were removed before analysis and donor confidentiality was preserved throughout.

RESULTS

Donation volume and growth

The eye bank received 320 donations over the 36-month window, yielding 638 corneas. Annual totals were 33 in 2022 (from April), 113 in 2023, 135 in 2024 and 39 in the first quarter of 2025. Monthly donation volume rose significantly over time (linear regression slope +0.27 donations per month; R^2=0.33; p<0.001), increasing approximately two-and-a-half-fold, from a mean of 4.5 donations per month in the first six months of operation to 11.2 in the final six (Figure 1).

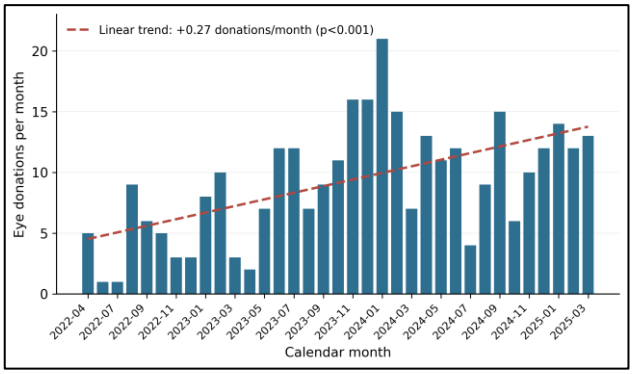

Figure 1: Monthly eye-donation volume at the eye bank from April 2022 to March 2025.

Fitted least-squares trend line (slope +0.27 donations per month; R^2=0.33; p<0.001).

Source and geography of procurement

The provenance of the tissue was the defining finding of this study (Table 1). Only 74 donations (23.1%) originated from the host district of Murshidabad, and just 7 (2.2%) were procured through the medical college's own HCRP despite its being a busy tertiary hospital. The overwhelming majority- 245 donations (76.6%)- were retrieved by a single, highly active external NGO ERC based in Santipur, in the neighbouring district of Nadia, with a further 67 (20.9%) from a local NGO ERC within Berhampore and one (0.3%) from another NGO ERC. More than three-quarters of the tissue that sustained the programme was therefore procured outside the district in which the eye bank stands.

Table 1: Source and geography of donor corneal tissue (n=320 donors).

Characteristics	Category	Frequency (%)
Procurement source	External NGO ERC (Santipur, Nadia)	245 (76.6)
	Local NGO ERC (Berhampore, Murshidabad)	67 (20.9)
	Own hospital HCRP (Murshidabad)	7 (2.2)
	Other NGO ERC	1 (0.3)
District of origin	Nadia (neighbouring)	245 (76.6)
	Murshidabad (host)	74 (23.1)
	Other	1 (0.3)

Note: ERC: eye retrieval centre; HCRP: hospital cornea retrieval programme; NGO: non-governmental organisation.

Donor demographic profile

Consistent with this geography, 318 donors (99.4%) were Hindu and only 2 (0.6%) were Muslim. Donors were elderly: the mean age was 72.3±12.2 years (range 14-95), 279 donors (87.2%) were aged 60 years or above and 90 (28.1%) were octogenarians or older, while only 41 (12.8%) were younger than 60 years (Table 2). One hundred and sixty-four donors (51.2%) were male and 156 (48.8%) females.

Consent and certified cause of death

Consent was granted by a son or daughter of the deceased in 237 cases (74.1%), by a spouse in 34 (10.6%), by a sibling in 24 (7.5%) and by another relative in the remaining 25 (7.8%), identifying offspring as the decisive decision-makers at the point of donation (Table 2). A certified cause of death was documented for 111 donors (34.7%); among these, cardiac and circulatory causes predominated (69; 62.2%), followed by cerebrovascular and neurological causes (16; 14.4%). No recorded cause constituted a contraindication to donation.

Table 2: Donor demographic, consent and mortality characteristics (n=320 donors).

Characteristics	Category	Frequency (%)
Age (years)	<60	41 (12.8)
	60-79	189 (59.1)
	≥80	90 (28.1)
Sex	Male	164 (51.2)
	Female	156 (48.8)
Religion	Hindu	318 (99.4)
	Muslim	2 (0.6)
Consenting next of kin	Son or daughter	237 (74.1)
	Spouse	34 (10.6)
	Sibling	24 (7.5)
	Other relative	25 (7.8)
Certified cause of death*	Cardiac or circulatory	69 (62.2)
	Cerebrovascular or neurological	16 (14.4)
	Other or unspecified	26 (23.4)

Note: SD: standard deviation. Mean donor age 72.3±12.2 years (range 14-95); 279 donors (87.2%) were aged ≥60 years. *Percentages for cause of death are calculated on the 111 donors (34.7%) for whom a cause was documented.

Table 3: Retrieval intervals overall and by procurement source.

Interval	Procurement source	N	Mean±SD (hours)	Median (hours)
Death to enucleation	All sources combined	273	3.71±1.56	3.52
Retrieval to eye bank (transport)	All sources combined	163	3.16	2.00
	External NGO ERC (Nadia)	94	4.31	3.38
	Local NGO ERC (Berhampore)	62	1.67	1.58
	Own hospital HCRP	7	0.90	0.92

Note: ERC: eye retrieval centre; HCRP: hospital cornea retrieval programme; NGO: non-governmental organisation; SD: standard deviation. The transport interval differed significantly across sources (Kruskal-Wallis H=31.81, p<0.001; external versus local ERC, Mann-Whitney p<0.001). The death-to-enucleation interval was longer for external-ERC than for local-ERC tissue (3.89 versus 3.11 hours; p<0.001). Enucleation was completed within six hours of death in 96.3% and within four hours in 59.3% of donations.

Retrieval logistics

The mean death-to-enucleation interval was 3.71±1.56 hours (median 3.52; n=273), with 96.3% of enucleations completed within six hours of death and 59.3% within four hours. The subsequent transport interval from retrieval site to eye bank, however, varied greatly by procurement source (Table 3). It averaged 4.31 hours for tissue retrieved by the external NGO ERC in Nadia, against 1.67 hours for the local ERC and 0.90 hours for the hospital's own HCRP (Kruskal-Wallis H=31.81, p<0.001; external versus local Mann-Whitney p<0.001), and reached 16 hours in the most distant case. The death-to-enucleation interval was also modestly but significantly longer for external-ERC than for local tissue (3.89 versus 3.11 hours; p<0.001). The tissue that made up the bulk of the supply therefore also travelled farthest and reached the eye bank latest.

Table 4: Retrieval and utilisation of donor corneal tissue over the study period.

Indicators	Value
Donors	320
Corneas retrieved	638
Keratoplasties performed	309
Corneas utilised for keratoplasty	309/638 (48.4%)
Transplant-grade corneas per donor	0.97

Note: Utilisation was calculated as the number of keratoplasties performed divided by the number of corneas retrieved over the same 36-month window.

Tissue utilisation

Of the 638 corneas retrieved, 309 (48.4%) were used for keratoplasty over the same period, equivalent to 0.97 transplant-grade corneas per donor (Table 4). Half of all

retrieved tissue therefore did not reach optical-transplant grade.

DISCUSSION

Three linked findings define the first three years of donor procurement at this peripheral government eye bank: the programme grew its donation volume rapidly, but only by looking outside its own district; local donation from the surrounding majority community remained minimal despite sustained effort; and the tissue on which the programme depended was, by virtue of its distant origin and the age of its donors, logistically and biologically disadvantaged.

The most sobering finding is how little tissue was obtained locally. Only 23.1% of donations came from the host district and a mere 2.2% through the institution's own HCRP. This is far below what comparable Indian programmes achieve. In a multicentre analysis of 20,564 corneas collected by 12 high-volume Indian eye banks, HCRP contributed 40.4% of all procurement, and in a north Indian eye bank followed over 16 years, 42% of donations were hospital-derived.[7,14] A recently established eye bank at a tertiary teaching hospital in Bihar, in eastern India, was able to run its entire early programme on HCRP retrievals alone.[15] Our HCRP contribution is therefore roughly twentyfold lower than the national multicentre figure, and the shortfall cannot be attributed to a lack of eligible deaths in a busy tertiary hospital. The explanation appears to lie with the request rather than the opportunity. Among 600 health professionals at an apex north Indian centre, knowledge of eye donation was adequate but only 6% had pledged their own eyes, and in a study from a tertiary hospital in eastern India awareness reached 95.6% while willingness to pledge was 51.5%, with practice scores significantly lower among nursing and paramedical staff (3.33±1.22 versus 3.74±0.64; $p<0.001$)- precisely the cadre in first contact with bereaved families.[16,17] A survey of 350 medical students and doctors similarly found substantial gaps in knowledge of donor eligibility criteria.[18] The programmatic implication is that sensitising a department is not the same as staffing a request: in a central Indian HCRP, dedicated eye donation counsellors were the single most influential facilitator of actual donation, cited in 57.5% of conversions.[19]

The second finding is a pronounced community-specific skew in the donor pool. That 99.4% of donors were Hindu, in a district where Muslims form approximately two-thirds of the population and accounted for three-quarters of the recipients served by the same programme, points unambiguously to a community-specific barrier to donation rather than to any shortage of potential donors. Our experience is consistent with, but considerably more extreme than, the gradients documented elsewhere in India: in the Delhi urban slum survey both awareness and willingness to pledge were significantly higher among Hindu respondents ($p<0.001$), and religious reasons accounted for 14.8% of stated refusals in the population-based Tripura survey.[9,10] The international evidence indicates that this barrier is informational and cultural rather than doctrinal. In multi-ethnic focus groups in Malaysia, the single most important information need expressed by Muslim participants was whether cadaveric donation is permissible in Islam, and participants across all communities wanted religious and community leaders to be visibly involved in any campaign.[20] In Saudi Arabia, a Muslim-majority country with an established health system, only 4.3% of 1,292 respondents believed they had sufficient knowledge about corneal donation, 66.3% remained undecided, and 40.2% stated they would be more willing to donate if better informed.[21] The same dissociation between attitude and knowledge is seen in other low- and middle-income settings: in a community-based survey of 760 adults in northwest Ethiopia, only 8.4% had good knowledge of eye donation although 59.9% held a favourable attitude, and attitude was independently associated with educational level and prior awareness.[22] The Perambalur study reached the same operational conclusion, recommending that awareness campaigns explicitly involve religious scholars.[12] Importantly, the gap we observed persisted despite continuous information-education-communication activity, staff sensitisation and community campaigns, which suggests that generic awareness measures are insufficient. Engagement must instead be tailored: working with imams and community leaders, recruiting counsellors from the same community and in the same language, addressing the specific misconception that donation disfigures the body or is religiously prohibited, and, as a case-control study of bereaved families in Madurai showed, simply making the request- 52.8% of non-donor families said they would have donated had someone asked or encouraged them.[23]

The reliance that followed from this shortfall carried a measurable logistic cost. A single external NGO ERC in the neighbouring district supplied more than three-quarters of our tissue. This dependence is double-edged. It demonstrates the capacity of an energetic charitable retrieval centre to sustain an entire district programme and underlines the value of ERC partnerships for peripheral units; equally, it concentrated the supply in one organisation and one district, a fragile and inequitable base, and it imposed a substantial transport penalty of 4.31 hours on average and 16 hours at the extreme, against under two hours for local tissue and under one hour for HCRP tissue ($p<0.001$). It is worth noting where the delay did and did not arise. Our death-to-enucleation interval of 3.71±1.56 hours compares favourably with the 4.74±5.31 hours reported from a north Indian eye bank, and 96.3% of enucleations were completed within six hours; the retrieval step was therefore performed promptly and the weak link was transport.[14] This distinction matters because the transport step is the more tractable of the two: evidence from a prospective study of 990 corneas shows that where the death-to-preservation time exceeded 12 hours, endothelial cell density was

significantly better in refrigerated donors ($p<0.001$), and that prolonged death-to-preservation time did not by itself worsen primary graft failure or graft infection.[24] Body refrigeration, in-transit cold-chain measures and additional nearer retrieval partnerships are therefore concrete, evidence-supported interventions rather than counsels of perfection.

Our utilisation rate of 48.4% should be read against this background. It sits close to the 50.5% reported across 12 high-volume Indian eye banks and to the approximately 50% benchmark for hospital-based retrieval nationally, and well above the 22–28% typical of voluntary donation.[6,7] That this was achieved with a markedly older donor pool is notable: our donors had a mean age of 72.3 years against 63.2 years in the north Indian series, in which the proportion of corneas used fell from 61.9% in donors under 30 years to 53.8% in those over 60 years, and a small eastern Indian HCRP series with a mean donor age of only 42.3 years achieved 87.0% utilisation while demonstrating a strong inverse correlation between donor age and endothelial cell density (Spearman $\rho=-0.747$; $p<0.001$).[14,15] The convergence in our programme of an elderly donor pool, long transport times and an optical-utilisation rate of 48.4% is internally coherent and consistent with this wider evidence, although we could not test the association directly.

Viewed as a whole, these findings reframe eye banking in a peripheral district as a public health and health-services problem rather than a purely clinical one. The programme's achievements are real: donation volume grew two-and-a-half-fold in three years, enucleation was accomplished within six hours in 96% of cases, and utilisation matched the national benchmark. A peripheral eye bank can therefore become a substantial supplier of transplantable tissue within three years. But in a community with low local donation it can do so only by building and depending upon external partnerships whose logistic cost must be actively managed, and the resulting mismatch between the community that donates and the community that receives is a question of equity as much as of supply.

The strengths of this work are that it captures the complete donation cohort of a defined district programme with no sampling, classifies every donation by source and geography, quantifies retrieval logistics from source timestamps rather than by recall, and links procurement to the recipient community the programme serves. Its limitations should be acknowledged. Endothelial cell density, tissue grading and serology were too incompletely recorded in the register to analyse, so the link between transport time, donor age and tissue quality could be inferred but not demonstrated within our own data. The transport interval was available for 163 of 320 donations (50.9%) and the death-to-enucleation interval for 273 (85.3%), and a certified cause of death was documented for only 34.7%, so these analyses are restricted to complete cases and may be subject to selection bias. Being a record-based study, it could not measure the knowledge, attitudes or stated reasons for refusal of the families who declined, which limits our ability to explain the community skew from primary data; the interpretation offered above rests on published survey evidence from comparable populations. However, the procurement challenges described are likely to be shared by other peripheral government eye banks also.

Public health implications

Our findings suggest five concrete priorities for district-level eye-banking programmes in similar settings. First, embed trained eye donation counsellors within the HCRP rather than relying on the sensitisation of clinical staff alone, since the request itself is the decisive step. Second, co-design community engagement with faith and community leaders of the local majority community, in the local language, targeting the specific misconceptions of bodily disfigurement and religious prohibition rather than delivering generic awareness messages. Third, diversify and shorten the supply line by developing additional nearer retrieval partnerships. Fourth, institute cold-chain measures and body refrigeration where retrieval must be delayed, so that the logistic penalty of distant procurement is not paid in tissue quality. Fifth, make systematic capture of specular microscopy and tissue grading a mandatory field in the donor register, so that the association between procurement logistics and tissue quality can be monitored prospectively and reported alongside NPCBVI programme indicators.

CONCLUSION

In its first three years a peripheral government eye bank in eastern India grew eye-donation volume rapidly and retrieved tissue promptly, yet local donation from the surrounding Muslim-majority community remained minimal despite sustained awareness activity, and the institution's own HCRP contributed almost nothing. The programme was sustained instead by an external NGO eye retrieval centre in a neighbouring district, at the cost of long transport times that, together with an elderly donor pool, are plausible contributors to the modest optical-utilisation rate. The growth of peripheral eye banking in such settings depends on two parallel investments: culturally tailored community and in-hospital engagement to widen the local donor base, and logistic strengthening to protect the corneas that distant partners so generously provide.

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